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# RESPONCE OF SOIL AND FOLIAR APPLICATION OF ZINC, IRON AND BORON ON LEAF NUTRIENT STATUS OF SAPOTA

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***ABSTRACT***

***The field experiment was conducted to know the response of soil and foliar application of zinc, iron and boron on leaf nutrient status of sapota cv. kalipatti under HDP system at Kittur Rani Chennamma College of Horticulture, Arabhavi during the year 2015-2016. Zinc and iron sulphates are used for soil and foliar application, boron for soil application sodium tetraborate (Jai bore) and for the foliar application solubor were used. The results revealed that foliar application 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ + 0.3% B shown significant increase of macro nutrients like nitrogen (1.75%), phosphorous (0.36 %), potassium (3.06 %) and optimum micronutrient content of zinc (17.60 ppm), iron (162.56 ppm) and boron (43.00ppm) was recorded in the leaf. By the above treatment high macro nutrients content, optimum zinc, iron and boron resulted in high yield and quality of fruits.***

***KEYWORDS:** Boron, Iron, Nutrient status, Sapota and Zinc*

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**Original Article**

## INTRODUCTION

The successful commercial cultivation of this crop is depend on many factors such as climate, soil, irrigation, fertilizer, spacing and season of growing etc. Among the different management practices, nutrient management plays an important role in growth, yield and quality fruits under high density planting (HDP) system. To perform sustainable yield and quality it need high amount of nutrients (Mishra, 2014).

The intensive and exploitative agriculture with high inputs and high yielding varieties and improved technologies which was helped better fruit production. But under high density planting competition for water and nutrients and the major nutrients usually supplied through straight fertilizers or mixture in an aggressive manner it lead to the depletion of micronutrients by maximum utilization it will ultimately resulting the loss in yield and quality. To sustain the yield and quality of fruit crops maintenance of micro and secondary nutrients becomes very pertinent to foresee the emerging nutrient deficiencies and to evolve suitable ameliorating technologies.

Sapota has the problem of low fruit setting and shedding of fruits. Only about 10-12 per cent of the total fruits set, and retains until maturity. Most of the fruit-drop occurs immediately after fruit setting. Increase in fruit set and retention are possible by spraying of boron (B), Iron (Fe) promotes formation of chlorophyll pigments, acts as an oxygen carrier and reactions involving cell division and growth. Zinc (Zn) aids in regulating plant growth hormones and enzyme system, necessary for chlorophyll production, carbohydrate and starch formation. Zinc is an

important for the formation and activity of chlorophyll and in the functioning of several enzymes and the growth hormone, auxin (Jeyakumar and Balamohan, 2013).

The foliar application of micro-nutrients have very important role in improving fruit set, productivity and quality of fruits. It has also beneficial role in recovery of nutritional and physiological disorders in fruit trees. Various experiments have been conducted earlier on foliar spray of micro-nutrients in different fruit crops and shown significant response to improve yield and quality of fruits (Kumar and Verma, 2004 and Dhinesh *et al.* (2005).

Therefore, based on the possible benefits of zinc, iron and boron the present study was planned to know the response of soil and foliar application micro nutrients on the following objective. To study the nutrient content in sapota leaf as influenced by application of zinc, iron and boron.

## MATERIALS AND METHODS

Experiment site was located in northern dry zone of Karnataka State at $16^o$ 15' North latitude, $74^o$ 45' East longitude and at an altitude of 612.05 m above the mean sea level. The average annual rainfall of an area 900 mm. The average maximum temperature of the location is 38 °C and the average minimum temperature is 14 °C and the relative humidity ranges from 60 to 90 per cent.

### Experimental Details

Field experiments were conducted at Kittur Rani Chennamma College of Horticulture, Arabhavi, Belagavi District during 2015-2016. Experiments were laid out in Randomized Complete Block Design with eleven treatments *viz.*, T1: control (no micronutrients), T2: (water foliar application), T3: ZnSO4 (50 g/plant soil application), T4: FeSO4 (40 g/plant soil application), T5: Boron (jai bore) 25 g/plant soil application, T6: ZnSO4 (foliar application) with 0.5 per cent, T7: FeSO4 (foliar application) with 0.5 per cent, T8: boron (solubor) foliar application at with 0.3 per cent, T9: ZnSO4 (50 g) + FeSO4 (40 g) + boron (25 g) for soil application. T10: ZnSO4 (0.5%) + FeSO4 (0.5%) + boron (0.3%) for foliar application. micronutrients (foliar application) and T11: T9 + T10. These nutrients are applied in two times as foliar i.e. $1^{st}$ at 50 per cent flowering and another at fruits at pea size. For soil application micronutrients applied along with RDF.

## LEAF ANALYSIS

### Leaf Sampling and Processing

Sapota leaves (20-30) were collected from the basal $10^{th}$ leaf of the shoot all around the tree canopy in each treatment at harvest period. Leaf samples were taken to the laboratory and processed. Leaf samples were washed in detergent followed by tap water and distilled water. Leaves were shade dried and then dried in hot air oven at 70°C for 48 hours. The dried leaves were grounded to fine powder by using mixer and stored in air tight butter paper bags for nutrient analysis.

The leaf samples were analysed for total nitrogen, phosphorous, potassium, micronutrients like iron, zinc and boron content in leaf by following standard methods of analysis. Estimation of total nitrogen, phosphorous and potassium were analyzed as per the procedure given by Jackson, 1973.

Micronutrients were estimated by directly feeding the filtered Di or tri acid extract of the plant sample to a calibrated atomic absorption spectrophotometer using respective hollow cathode lamps for each element (Fe, Zn,).

Micronutrient concentration was expressed in parts per million (ppm) on dry weight basis (Page *et al*., 1982).

**Statistical Analysis of Experimental Data**

The experimental data collected relating to different parameters were statistically analysed as described by Sundar Raj *et al.* (1972) and the results were tested at 5 per cent level of significance by Fischer method of analysis of variance.

## RESULTS AND DISCUSSIONS

The maximum nitrogen content (1.75 %) was recorded in $T_{10}$ (foliar application of $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5%) + B (0.3% per tree) and the lowest (1.17 %) was recorded in the $T_1$ (Table 2). It seems that, the micronutrients will enhance uptake of other nutrients. The boron and zinc play important role in nitrogen metabolism and it will helps optimum nitrogen absorption. Similar results were noticed by Baiea *et al.* (2015) in mango, Khan *et al.* (2015) in Kinnow mandarin and lalithya *et al*., 2014 in sapota.

The highest phosphorous content in the leaf (0.36 %) was recorded in treatment with foliar spray of $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5%) + B (0.3%) per tree and the lowest (0.195 %) was recorded in $T_{11}$ (Table 2). It seems that, the micronutrients will enhance uptake of other nutrients like NPK by nitrogen metabolism and the optimum nitrogen enhances the absorption of other nutrients like P and K. Similar results were noticed by Baiea *et al*. (2015) in mango and Khan *et al.* (2015)in Kinnow mandarin.

The highest potassium content in the leaf (3.06 %) was recorded in treatment with foliar spray of $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5%) + B (0.3%) per tree and lowest was recorded in $T_{11}$ (Table 2). This might be due to more accumulation of potassium in leaf content. It seems that, the micronutrients will enhance uptake of other nutrients like boron and zinc play important role in nitrogen metabolism and the optimum nitrogen enhances the absorption of other nutrients like P and K. But in $T_{11}$ the lowest amount of potassium has recorded due to toxic levels of applied micronutrients and the similar results were noticed by Baiea *et al*. (2015) in mango and Khan *et al.* (2015) in Kinnow mandarin.

The highest zinc content in the leaf (73.71 ppm) was recorded in treatment $T_{11}$ ($T_9$ + $T_{10}$), and minimum zinc was found in $T_1$ and $T_2$ (14.51 and 14.85 ppm) (Table 3). The highest zinc due to high availability, increased absorption capacity by soil and foliar spray and the optimum zinc content in $T_1$ because of optimum available zinc soil and the findings similar to that of Ebbs and Kochin (1997) in brassica species and Paparnakis *et al.* (2013) in apple. But to high yield and quality of sapota optimum Zn (13.20 to 21.90 ppm) is essential (Savita and anjaneyulu, 2008 in sapota cv. Kalipatti). It was obtained in $T_{1,}$ $T_{2,}$ $T_{4,}$ $T_{5,}$ $T_{7,}$ $T_8$ and $T_{10.}$ The optimum zinc in $T_1$, $T_2$, $T_4$, $T_5$, $T_7$ and $T_8$ due to soils found to optimum Zn (Table 1). Where in $T_3$, $T_6$, $T_9$ and $T_{11}$ additional application of Zn has shown toxicity level of zinc content in leaf (Table 2).

The highest iron content in the leaf (256.24 ppm) was recorded in $T_{11}$ ($T_{9+}$ $T_{10}$). The highest iron due to high availability, increased absorption capacity by soil and foliar spray and the lowest iron content in $T_3$ due to the soil having optimum available zinc, by manual application had reached toxic level which may hinder iron absorption capacity and the findings similar to that of Fang and Jaiwevi (2006) in citrus. But to high yield and quality of sapota optimum Fe (108 to 208 ppm) is essential (Savita and anjaneyulu, 2008 in sapota cv. Kalipatti). Optimum iron content obtained in all treatments except in $T_{11}$. In $T_{11}$ iron (Fe) fund to toxic it may be due to soil and foliar application.

**Table 1: Initial Nutrient Status of Sapota Plants Selected for Experiment**

| S. No. | Nutrients | Nutrient Status |
|---|---|---|
| 1 | Nitrogen content in Sapota leaf (%) | 1.50 |
| 2 | Phosphorous content in Sapota leaf (%) | 0.24 |
| 3 | Potassium content in Sapota leaf (%) | 2.06 |
| 4 | Zinc content in sapota leaf (ppm) | 15 |
| 5 | Iron content in sapota leaf (ppm) | 159 |
| 6 | Boron content in sapota leaf (ppm) | 55 |

**Table 2: Effect of Soil and Foliar Application of Zinc, Iron and Boron on Leaf Nutrient Status of Sapota Cv Kalipatta under High Density Planting System**

| Treatments | Leaf Nutrient Contents | | |
|---|---|---|---|
| | N (%) | P (%) | K (%) |
| $T_1$- Control (RDF) | 1.35 | 0.21 | 2.03 |
| $T_2$- RDF + Water spray | 1.40 | 0.22 | 2.13 |
| $T_3$- RDF + 50 g $ZnSO_4$ per tree (SA) | 1.52 | 0.25 | 2.59 |
| $T_4$- RDF + 40 g $FeSO_4$ per tree (SA) | 1.60 | 0.29 | 2.83 |
| $T_5$- RDF + 25 g B per tree (SA) | 1.60 | 0.28 | 2.96 |
| $T_6$- RDF + 0.5% $ZnSO_4$ per tree (FA) | 1.27 | 0.21 | 2.35 |
| $T_7$- RDF + 0.5% $FeSO_4$ per tree (FA) | 1.55 | 0.27 | 3.06 |
| $T_8$- RDF + 0.3% B per tree (FA) | 1.55 | 0.29 | 3.09 |
| $T_9$- RDF + 50 g $ZnSO_4$+40 g $FeSO_4$+ 25 g B per tree (SA) | 1.53 | 0.27 | 2.97 |
| $T_{10}$- RDF + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ + 0.3% B per tree (FA) | 1.75 | 0.36 | 3.06 |
| $T_{11}$- $T_9 + T_{10}$ | 1.26 | 0.18 | 1.95 |
| S. Em ± | 0.05 | 0.01 | 0.08 |
| C. D. at 5% | 0.15 | 0.03 | 0.23 |

RDF – Recommended dose of fertilizer SA –Soil Application FA – Foliar Application

**Table 3: Effect of Soil and Foliar Application of Zinc, Iron and Boron on Leaf Nutrient Status of Sapota cv Kalipatta under High Density Planting System**

| Treatments | Leaf Nutrient Contents | | |
|---|---|---|---|
| | Zn (ppm) | Fe (ppm) | B (ppm) |
| $T_1$- Control (RDF) | 14.51 | 159.03 | 52.33 |
| $T_2$- RDF + Water spray | 14.85 | 153.88 | 41.67 |
| $T_3$- RDF + 50 g $ZnSO_4$ per tree (SA) | 34.57 | 112.02 | 61.00 |
| $T_4$- RDF + 40 g $FeSO_4$ per tree (SA) | 17.35 | 142.45 | 60.00 |
| $T_5$- RDF + 25 g B per tree (SA) | 15.61 | 115.61 | 50.00 |
| $T_6$- RDF + 0.5% $ZnSO_4$ per tree (FA) | 54.01 | 130.26 | 49.33 |
| $T_7$- RDF + 0.5% $FeSO_4$ per tree (FA) | 21.67 | 208.20 | 61.50 |
| $T_8$- RDF + 0.3% B per tree (FA) | 18.72 | 122.72 | 47.50 |
| $T_9$- RDF + 50 g $ZnSO_4$+40 g $FeSO_4$+ 25 g B per tree (SA) | 55.62 | 124.51 | 46.50 |
| $T_{10}$- RDF + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ + 0.3% B per tree (FA) | 17.60 | 162.56 | 43.00 |
| $T_{11}$- $T_9 + T_{10}$ | 73.71 | 256.24 | 88.67 |
| S. Em ± | 0.64 | 0.91 | 1.01 |
| C. D. at 5% | 1.87 | 2.69 | 2.99 |

**RDF** – Recommended dose of fertilizer **SA** –Soil Application **FA** – Foliar Application

The highest boron content in the leaf (88.67 ppm) was recorded in $T_{11}$ ($T_{9+}$ $T_{10}$). However the lowest boron content (41.67) in leaf tissues has recorded in $T_2$ The highest boron in leaf tissues due to high availability, increased absorption capacity by soil and foliar sprays the findings similar to that of Lenny and Patrick (2008) in pecan nut and Sayed *et al.,* 2012. But to high yield and quality of sapota optimum B (34.7 to 66.80 ppm) is essential (Savita and anjaneyulu, 2008 in sapota cv. Kalipatti). Optimum boron content was observed in all treatments except in $T_{11}$. In $T_{11}$ boron (B) fund to toxic it may be due to soil and foliar application.

## CONCLUSIONS

In conclusion the result of this study highlights the role of zinc, iron and boron in improving the nutrient content in sapota cv. Kalipatti under HDP system. By using zinc (0.5% $ZnSO_4$), iron (0.5% $FeSO_4$) and boron (0.3% B) foliar application helped in more utilization of macro & micronutrients and thus resulted in obtaining more yield and quality of sapota.

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